# A PRELIMINARY STUDY OF THE ROOT DEVELOPMENT OF CERTAIN SOUTH AFRICAN HIGHVELD GRASSES.

By S. M. Murray, B.A. (Cantab.), M.Sc. (Rand), and P. Glover.
(*Botanical Department, University of the Witwatersrand, Johannesburg*)

While engaged upon investigations into the response of natural grassveld to fertilizers under conditions of controlled grazing at the botanical research station of the University of the Witwatersrand, the writers decided, at the suggestion of Professor John Phillips, to commence a study of the root systems of the different grass species occurring within the experimental areas. The difficulty in obtaining information on the grasses from this aspect, made it necessary to make a preliminary study of some of the more commonly occurring species, and it is the object of this paper to record the results of this study and to describe the technique employed.

## Procedure.

The procedure adopted in making these investigations is based upon descriptions of the study of the root development of plants by Weaver (1919 and 1926), who has carried out extensive investigations in the United States.

A pit is dug near the plant to be studied so that a clear-cut working face of sufficient area is exposed to include the estimated extent of the root system. The face is then marked out in 6-in. squares with string stretched between wire pegs. Excavation of the roots is then commenced in the square adjacent to the base of the plant, and these roots are charted to scale on squared paper: a scale of $2'' = 6''$ is found most convenient. The remaining squares are then excavated and charted and the working face increased in size if necessary, until finally a bisect of the entire root system is obtained. As the work progresses, notes are made upon the frequency of branching and any other marked characteristics of the roots, and also the types of soil encountered at different depths.

Since the grass roots studied were mostly very fine and delicate, and the soil hard and dry, various methods of excavating the roots had to be tried before satisfactory results could be obtained. The first method tried consisted of picking away the soil with thick wire implements sharpened to a fine point, but although these were found useful for digging away superficial soil from the coarser roots, they were too clumsy for

working with the finer ones and ordinary dissecting needles were tried for the latter purpose. Even with these fine tools, however, roots were frequently broken off either by the dissecting needles themselves or by clods of earth coming away with portions of the root embedded in them: moistening the soil with water was not sufficient to prevent this.

The method that finally proved quite the most satisfactory was to wash away the soil with a strong jet of water from a garden spray foot-pump. It was found that by directing the jet almost parallel with the roots there was very little danger of breakage, and they could be exposed right to their extremities in this way. If a root was found to travel slightly away from the working face, it was a simple matter to make preliminary excavations with the implements described above using the jet of water for the more delicate work of exposing the root.

The greatest difficulty was experienced when the roots had to be followed into and through beds of Iron sesquioxide (murram ; ou' klip ; pea-ironstone) which were struck at depths of from 3-4 feet in these areas. Many of the deeper roots were broken off on account of this, but in nearly every plant studied, some idea of the maximum root depth was obtained by the workers, who succeeded in tracing at least one or two of these roots down crevices in the rock to their extremities.

Naturally, in this type of root study, only the roots that occurred in the one plane parallel to the working face were studied, the remainder either having been broken off in the digging of the pit or being impossible to follow due to their distance from the working face.

## Discussion of Results.

The species selected for this preliminary study were :—*Themeda triandra*, Forsk., *Cymbopogon plurinodis*, Stapf., *Tristachya Rehmannii*, Hack., *Elyonurus argenteus*, Nees., *Digitaria tricholaenoides*, Stapf., *Brachiaria serrata*, Stapf., *Cynodon dactylon*, Pers., which were all found growing in the granite soils of the typical grassveld in this area. Up to the present it has been possible to chart only one root system of each species selected, as the time taken is usually one day for each. Although it will be necessary to replicate this work for conclusive results, the charts now to hand show some very marked characteristics which are worthy of mention.

From the differences in the layout of the root system it was possible to divide the above species into three distinct classes :—

1. Those with superficial root systems.
2. Those with deep root systems.
3. Those with deep roots but also having well developed lateral roots for surface feeding.

1. The two species in this class are *Themeda* and *Cymbopogon plurinodis*. From Fig. 1, it will be seen that the former has a very much branched and shallow root system which extends a considerable distance in a horizontal direction forming a close network a few inches from the surface of the soil. Some of the roots descended vertically to a depth of about one foot and some appeared to go further, but these could not be traced back to the plant. These deeper roots, however, were few. The similarity between the root systems of *Themeda* and *Cymbopogon* was very noticeable, but in the individual case studied both the lateral spread and the maximum depth was greater. From this it is reasonable to suppose that these two species are able to make use of surface soil water and nutrients before

Fig. 1. *Themeda triandra*. Scale, 1 in. = 6 ins.

they reach the deeper rooted pioneer species, and that they belong to a stage approaching the climax in the grassland succession.

2. In this class come *Digitaria tricholaenoides*, *Tristachya Rehmannii*, and *Elyonurus argenteus*, the root systems of which form a very marked contrast with those in class 1. There is much less branching and very poor development of laterals, the roots for the most part travelling vertically downwards to a depth of about 3 feet and branching more profusely towards the extremities. Fig. 2 shows these characters clearly exemplified by *Digitaria tricholaenoides*.

3. *Brachiaria serrata* and *Cynodon dactylon* form good examples of this class of root system. In the case of *Brachiaria*, a few roots penetrated to a depth of 4—5 feet, besides there being a strong development of lateral roots at the surface. *Cynodon* shows this characteristic to an even greater

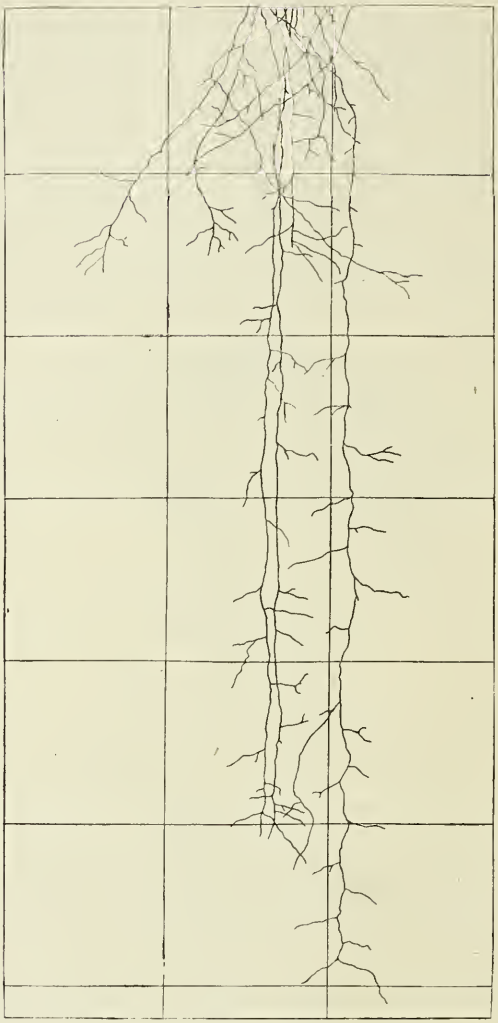

FIG. 2. *Digitaria tricholaenoides.* Scale, 1 in. = 6 ins.

degree, and it can be seen from Fig. 3 how well developed and branched are the roots near the surface and at the extremities of the deepest roots, as compared with the intervening section.

It would appear from this that these two species would be able to compete with any of the above species, and the even distribution of *Brachiaria*

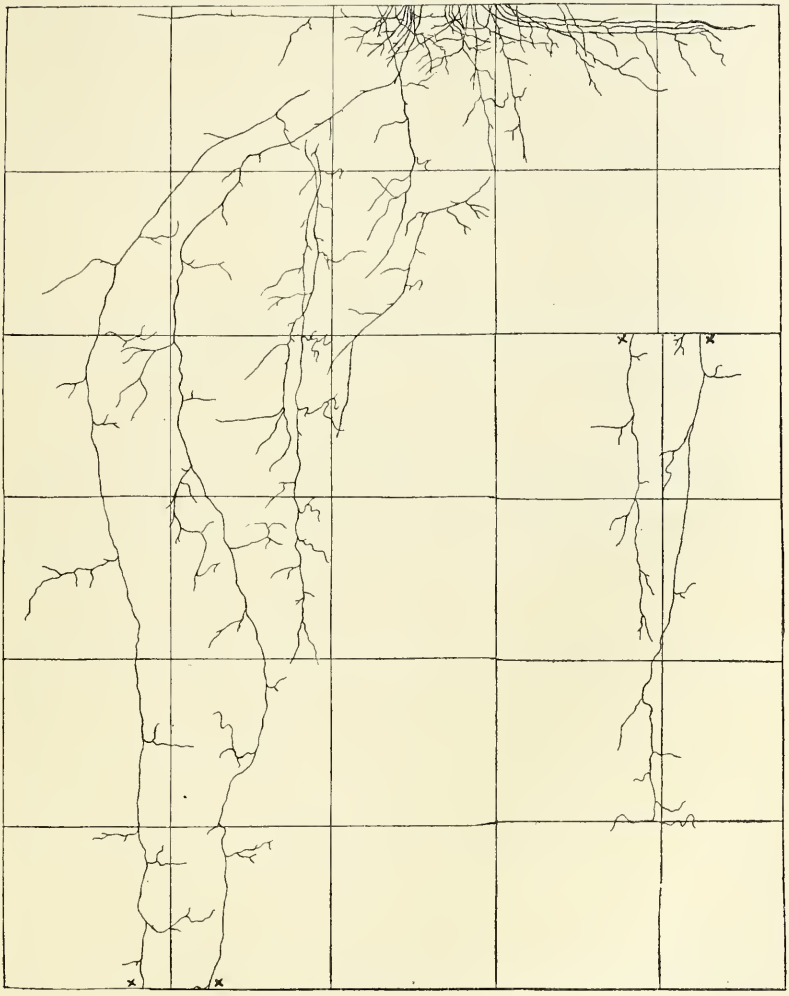

Fig. 3. *Brachiaria serrata.* Scale, 1 in. = 6 ins.

*serrata* in this veld seems to bear out this statement. *Cynodon dactylon*, however, which appears to be a light demanding species with a prostrate

habit, is only found to any extent as a coloniser of bare areas, in primary and secondary successions.

In discussing the results of this preliminary study, it must be emphasised that it is the intention of the writers to replicate the work on the above species, in order to make sure that the charts are representative of the species in each case. It is also hoped that, with the recommencement of these investigations, other workers will work concurrently upon the detailed structure of the roots, and upon the analysis of soil samples taken at depths where maximum root development takes place. These and many other important fields of study are opened up when a plant is studied from below as well as above ground level.

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